Several countries have adopted the IAEA's method to establish their own national auditing networks. Further development is being considered to check not only the reference condition, i.e.beam calibration, but also non-reference conditions, such as irregularly shaped and wedged beams, rotational, helical or not intensity modulated RT beams(Table), proton therapy beams.

Reference	Region	Average	SD (%)
Gillis et al., 2005 ESTRO-QUASIMODO	Europe	1.014 0.997	1.6 3.6
Tomsej et al., 2005 GORTEC	Europe	0.992	3.9
Ibott et al., 2006 RPC-RTOG	US	0.99 0.99	8 7
Tomsej et al., 2007 ESTRO-OECI	Europe	0.966 0.978	2.4 1.5

ESTRO booklet 9 Guidelines for the verification of IMRT, Table 7.3: Results from studies of the accuracy of dose determinations of IMRT treatments.

Recent advances in radiotherapy focus on the need for a systematic quality assurance program that balances patient safety and quality with available resources. External audit programmes for radiotherapy QA are also effective. Both postal dosimetry audit and clinical trial radiotherapy QA, especially for advanced technologies, in collaboration with global networks, will serve to enhance patient safety and quality of care.

PROFFERED PAPERS: PHYSICS 9: TREATMENT PLANNING

OC-0429

Accuracy of photon dose calculation under jaw and MLC shielding

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Purpose/Objective: The accuracy of photon dose calculation in the out-of-field regions is often neglected despite its importance for organs at risk and peripheral dose evaluation. The present work assessed the dose calculation accuracy of the Anisotropic Analytical Algorithm (AAA) and the Acuros XB algorithms implemented in the Eclipse treatment planning system, in the regions shielded by the jaw, or the MLC, or both MLC and jaw for flattened (6 and 10 MV) and unflattened (6 and 10 FFF MV) beams. The largest difference to out-of-field dose coming from the two beams (flattened and unflattened) is due to the head scatter, where for FFF beams a lower contribution is expected due to the lack of flattening filter scattering.

Materials and Methods: Six and 10 MV, flattened and unflattened beams, were from a TrueBeam (Varian Medical Systems, Palo Alto, USA), equipped with Millennium 120-MLC. Depth doses in water, out of the field, parallel to the field edge were acquired at 1, 2, 3, 5 and 10 cm distance from the field edge. Lateral field side was set as 1, 5 and 10 cm. The following shielding modalities were used to set the beam: (1) jaw defined field (MLC retracted); (2) MLC defined field (jaws set to 40x35 cm^2); (3) jaw+MLC defined field (both positioned at the field edge). Measurements were acquired with a 0.125 cm^3 ion chamber. All measurements were then compared with the corresponding AAA and Acuros XB calculations (version11.0.21) in water.

Four volumetric modulated arc therapy plans (in the RapidArc form) were optimized in a water equivalent phantom, PTW Octavius, in a way to have a region always shielded by the MLC or jaw+MLC during the delivery. A structure was delineated mimicking the target with the anterior part of a ring shape of 6 cm external diameter and 3 and 4 cm thickness (two optimizations); the organ to spare was a cylindrical volume at distance of 0.5 cm from the target and with a radius of 2 and 1 cm, respectively. Doses to seven points located in the shielded region and in the target like structure were measured with a 0.125 cm^3 ion chamber. Results were compared with the AAA and Acuros XB calculations in terms of absorbed dose in a volume as the ion chamber sensitive volume.

Results: In general a good agreement between calculation and measurements was found for both algorithms. From depth dose analysis the 10 FFF beam resulted, as expected, to offer the lowest out-of-field dose. The overall average difference (all energies and shielding methods) between measurements and calculations were below 0.6% for AAA and below 0.8% for Acuros XB.

From RapidArc plans analysis the average differences between calculation and measurement in the shielded region were -0.9%±0.4% and -3.1%±1.3% for AAA and Acuros XB, respectively, relative to the mean target dose value. Differences in the target structure were of -0.5%±2.3%, -0.7%±2.3% for AAA and Acuros XB, respectively.

Conclusions: The high accuracy required to properly evaluate the out-of-field dose can be achieved with the analysed algorithms, AAA and Acuros XB that showed an accuracy degree in those low dose regions similar, relatively to in-field dose, to what obtained for open beams.

OC-0430

A novel concept for history based evaluation of target dose distribution in multiple dose level treatment plans

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Purpose/Objective: Assessment of acceptable target dose conformity in plans with multiple prescription levels is a challenge due to the inevitable over/underdosage at the borderline between dose levels. Here, we propose a tool for the evaluation of target dose in treatment plans with multiple dose levels, providing a possible contribution to level 3 reporting in ICRU report 83. We illustrate the potential of the tool in identifying a single plan as suboptimal and identifying a systematic change in planning priorities in our institution between 2010 and 2012.

Materials and Methods: Dose painted treatment plans with five dose levels (DP plans) were evaluated for 20 head and neck cancer patients. As a complement to *structure specific* dose parameters, *plan specific* parameters describing the target dose were used for the quality assessment tool. The quality value Q was the basis for the evaluation and was used to obtain quality volume histograms (QVH):

$$Q = \frac{D_{obtained}}{D_{prescribed}}$$

A one-dimensional measure, the quality factor, QF, has previously been used[1] to evaluate target dose:

$$QF = \frac{1}{n}\sum_{p=1}^{n}\left(\left|Q_p - 1\right|\right)$$

where n is the number of voxels and Qp is the qualityvalue in voxel p.

We propose to supplement this measure with a 2D *QVH tool* that is based on the experience from previous similar treatment plans. For each Q value, the median relative volume, V, and interquartile range (iqr) among the group of historical plans was found. An area on the QVH corresponding to median(V) ±1.45*iqr was outlined, which in case of normal distribution includes 95% of the plans. When evaluating the QVH of a new plan, this tool can be used to identify poorer than usual dose conformity. We overlaid the QVH plots of 13 clinical hypopharyngeal plans from 2010 with 13 hypopharyngeal plans from 2012, and used the QVH tool to identify a change in plans over time.

Results: Figure 1 illustrates that one of 20 H&N DP plans was identified as suboptimal by the QVH tool, even though it met all planning constraints. The plan had more overdosage than what should be expected, and was reoptimized and improved (Figure 1, thick dark line). The plan QF decreased from 0.056 to 0.045, corresponding well to the group average: mean QF 0.047 (range 0.039-0.056).

Comparison of the 2010 and 2012 plans with the QVH tool clearly demonstrated that current treatment plans have less underdosage at the expense of more overdosage when compared to the 2010 plans. This change is not associated with a change in QF.